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(54) CONDUCTIVE MATERIAL FOR ELECTRONIC COMPONENT

(57)Abstract:

PROBLEM TO BE SOLVED: To realize a conductive material for an electronic component, which is restrained from deteriorating in solderability when the

conductive material is heated in a manufacturing process by a method wherein a base layer of Ni or Ni alloy is formed on the surface of a conductive base body, an intermediate layer of Pd or Pd alloy prescribed in thickness is formed thereon, and a surface layer of Au or Au alloy prescribed in thickness is formed thereon. SOLUTION: A conductive base body is formed of an arbitrary metal material such as Cu or Cu alloy wire of high electrical conductivity. A base layer is formed of Ni or Ni alloy which has high heat resistant properties. An intermediate layer is formed of Pd or Pd alloy which improves a conductive material of this constitution in solderability. The intermediate layer is formed as think as 0.005 to 0.1μm. A surface layer is formed of Au or Au alloy which has high resistance to oxidation and enhance the conductive material of this constitution in solderability. The surface layer is formed as thick as 0.001μm (monoatomic layer) to 0.1μm. A conductive base body is successively plated with a base layer, an intermediate layer, and a surface layer. By this setup, the conductive base body excellent in solderability can be obtained.

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CLAIMS

[Claim(s)]

[Claim 1] The substrate layer of nickel or nickel alloy is formed in the front face of a conductive base, and thickness on it 0.005-0.1 Pd of mum or the interlayer of Pd alloy is formed, and it is a monoatomic layer (0.001 micrometers) on it further. From thickness Electrical conducting material for electronic parts characterized by forming Au of 0.1-micrometer thickness, or the surface of Au alloy.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the electrical conducting material for electronic parts which has improved soldering nature.

[0002]

[Description of the Prior Art] The lead section for connecting each component section to various electronic parts, such as semi-conductors, such as diode, a transistor, and IC, a capacitor, and resistance, in external circuits, such as a printed circuit board, is formed. Among these, the ingredient many of lead wire and leadframes carried out [the ingredient] nickel plating at wire rods, such as Cu alloys, such as Cu, Cu-Fe, Cu-Zn, and Cu-Sn, or Cu covering steel wire, is mainly used. However, since nickel plating layer tends to have oxidized, when said lead wire etc. made connection with an external circuit with soldering, it needed to remove the oxide film of nickel plating layer using the strong flux of oxidizing power. There was a problem that work environment got worse for this reason. Since it is such, in order to improve the soldering nature of nickel plating lead wire, lead wire in which Pd or Pd alloy layer which cannot oxidize easily on nickel plating layer was formed was proposed (JP,59-149609,A).

[0003]

[Problem(s) to be Solved by the Invention] By the way, by manufacture of a semi-conductor, it is lead material to Si chip. It solders at the elevated temperature of 350 - 400 **. Moreover, KYUA of Si resin is in atmospheric air. It is heated and made by 200 - 250 **. When such the heat history was received, also with the lead wire which galvanized Pd (Pd alloy) layer on the aforementioned surface, said Pd (Pd alloy) layer oxidized slightly, and there was a problem that soldering

nature with an outer conductor fell. This invention aims at offer of the electrical conducting material for electronic parts with which soldering nature does not fall even if heated by the production process.

[0004]

[Means for Solving the Problem] the substrate layer of nickel or nickel alloy forms invention according to claim 1 in the front face of a conductive base -- having -- a it top -- thickness 0.005-0.1 Pd of mum or the interlayer of Pd alloy forms -- having -- further -- a it top -- thickness -- a monoatomic layer (0.001 micrometers) -- it is the electrical conducting material for electronic parts characterized by forming the surface of Au which is - 0.1micrometer, or Au alloy.

[0005]

[Embodiment of the Invention] Although the electrical conducting material for electronic parts of this invention formed nickel (nickel alloy) layer and Pd (Pd alloy) layer in order on the conventional conductive base, the soldering nature which formed further upwards Au (Au alloy) layer which is excellent in oxidation resistance, and said Au (Au alloy) layer prevented oxidation of Pd (Pd alloy) layer upwards, and excelled [upwards] in Pd (Pd alloy) is made to be discovered effectively.

[0006] In this invention, the metallic material of the arbitration which has conductivity including Cu or Cu alloy wire rod is used for a conductive base. The conductive base which has Cu layer or Cu alloy layer on a front face at least especially excels in plating nature and is desirable. A conductive base is selected according to the mechanical strength and the conductive criteria of the various lead sections. For example, when a mechanical strength is thought as important, Cu alloy or Cu covering steel materials is chosen, and Cu is chosen when conductivity is thought as important.

[0007] nickel or nickel alloy is used for a substrate layer in this invention. Said nickel or nickel alloy achieves the duty as a barrier which is excellent in thermal resistance and prevents the diffusion to the surface of a conductive base in various heating processes. In said nickel alloy, they are a nickel-Co system, a

nickel-Fe system, a nickel-Zn system, a nickel-Sn system, and nickel-Co-P. nickel alloy of arbitration, such as a system, is applicable.

[0008] Pd or Pd alloy is used for an interlayer in this invention. Said Pd or Pd alloy raises soldering nature. A Pd-nickel system alloy etc. is applicable to said Pd alloy. an interlayer's thickness 0.005-0.1 in the reason specified to mum, and less than 0.005 micrometers, the effectiveness is not fully acquired -- it is because the effectiveness will be saturated if 0.1 micrometer is exceeded, and it becomes causing a cost rise.

[0009] Au or Au alloy is used for a surface in this invention. Said Au or Au alloy raises soldering nature that it is hard to oxidize. Alloys, such as an Au-Pd system, an Au-Co system, an Au-nickel system, and an Au-Ag system, are applicable to said Au alloy. the thickness of said surface -- a monoatomic layer (0.001 micrometers) -- by the thickness of under a monoatomic layer, the effectiveness completely acquires the reason specified to - 0.1micrometer -- not having -- 0.1 It is because there is a possibility that a Sn-Au system intermetallic compound will increase into solder, soldered joint nature will deteriorate if mum is exceeded, and lead wire may fall out.

[0010] The manufacture approach of the lead wire of this invention supplies for example, a conductive base continuously, and the approach of electroplating a substrate layer, an interlayer, and a surface in order on it is rich and suitable for productivity. Although many nonelectrolytic plating is conventionally adopted as the nickel-B system alloy and nickel-P system alloy of a substrate layer, the electroplating of a plating rate is more advantageous in [it is quick and] cost.

[0011]

[Example] Below, an example explains this invention at a detail. It runs. The head end process of electrolytic degreasing, rinsing, acid washing, and rinsing was given to the oxygen-free-copper line of 0.6mmphi, subsequently the plating process of substrate layer plating, rinsing, interlayer plating, rinsing, surface plating, rinsing, and desiccation was given, this was rolled round to the coiled form, and lead wire was manufactured. Pretreatment, the plating of each class,

and the plating facility that can perform rolling up continuously were used for the manufacturing facility. various the quality of the materials and thickness of a substrate layer, an interlayer, and a surface were boiled, and were changed. Lead wire was manufactured by the approach same also about that in which an interlayer's thickness does not have a thing besides a convention of this invention, and Au (Au alloy) layer as an example for the comparison.

[0012] Plating conditions are described below.

[nickel plating]

Plating liquid: NiSO4 240 g/l, NiCl2 45 g/l, H3BO3 30 g/l.

Plating conditions: Current density 5 A/dm2, temperature 50 degrees C.

[nickel-5wt%Co alloy plating]

Plating liquid: NiSO4 240 g/l, NiCl2 45 g/l, CoSO4 15 g/l, H3BO3 30 g/l.

Plating conditions: Current density 5 A/dm2, temperature 55 degrees C.

[Pd plating]

Plating liquid :P d(NH3)2Cl2 40 g/l, NH4OH 90 ml/l, 2(NH4) SO4 50 g/l.

Plating conditions: Current density 1 A/dm2, temperature 30 degrees C.

[Pd-20wt%nickel alloy plating]

Plating liquid: Pd(NH3)2Cl2 40 g/l, NiSO4 45 g/l, NH4OH 90 ml/l, 2(NH4) SO4 50 g/l.

Plating conditions: Current density 1 A/dm2, temperature 30 degrees C.

[Au plating]

Plating liquid: KAu(CN) 2 15 g/l, KCN 30 g/l, K2CO3 30 g/l, Na2HPO4 20 g/l.

Plating conditions: Current density 0.5 A/dm2, temperature 60 degrees C.

[0013] It is in atmospheric air about each obtained lead wire. After heating at 180 degrees C for 24 hours, solder wettability and soldered joint nature were investigated. Solder wettability It investigated according to the MIL method. Namely, after cutting lead wire in die length of 30mm, considering as a pin and an acetone's washing this enough It was immersed in the eutectic solder bath heated at 230 degrees C for 5 seconds, and the area (wetted area) of the solder adhering to a pin was measured using the 15 times as many magnifier as this.

This soldering arrival area was **(ed) in the immersion area of a pin, and solder wettability was expressed. It is immersed in an eutectic solder bath in each lead wire, makes solder adhere, soldered joint nature contacts a copper strip in this soldering arrival part, and it solders lead wire and a copper strip, and is this soldered lead wire and soldered copper strip. To the inside of a 155-degree C airbus Respectively on both sides of lead wire and a copper strip, it investigated by performing a tension test by the chuck after 100-hour neglect. Soldered joint nature judged that from which exfoliation produced [soldered joint nature] what was fractured between ** and solder between fitness (O), a plating layer, and solder to be a defect (x). It performed the above-five trial at a time about each sample. A result is shown in Table 1.

[0014]

[Table 1]

分類	No	下地層		中間層		表層		半田濡れ性※ %	半田接合性§
		材種	厚さ μm	材種	厚さ μm	材種	厚さ μm		
本発明例	1	Ni	0.5	Pd	0.005	Au	0.001	95.2	○
	2	Ni	0.5	*Pd-Ni	0.01	Au	0.01	98.1	○
	3	Ni	0.5	Pd	0.01	Au	0.1	98.7	○
	4	Ni	0.5	Pd	0.1	Au	0.01	99.2	○
	5	#Ni-Co	0.5	Pd	0.01	Au	0.01	98.2	○
比較例	6	Ni	0.5	Pd	0.003	Au	0.01	83.0	○
	7	Ni	0.5	Pd	0.01	なし		60.5	○
	8	Ni	0.5	Pd	0.1	なし		74.8	○
	9	Ni	0.5	Pd	0.1	Au	0.2	99.5	×

(Note) *:5 average. Section: Five, O is O and x is x five.

* :P. d-20wt%nickel Alloy. # :nickel-5wt%Co alloy.

[0015] It is the lead wire of this invention so that more clearly than Table 1. (No.1-5) Each is excellent in solder wettability and soldered joint nature. On the other hand, since No.6 of the example article of a comparison had thin Pd layer, solder wettability fell. moreover, No. -- since 7 and 8 do not have Au layer -- inside of atmospheric air The front face of Pd layer oxidized slightly with heating which is 180 degrees C, and solder wettability fell. No.9 are this although degradation is looked at by junction nature. It is because many Au-Sn system intermetallic compounds were formed.

[0016] As mentioned above, although lead wire was explained, the same effectiveness is acquired even if a leadframe etc. uses the electrical conducting material of this invention for other lead sections.

[0017]

[Effect of the Invention] As stated above, since the lead wire of this invention is what formed in the surface Au layer or Au alloy layer which is excellent in oxidation resistance, oxidation of Pd of the lower part or the interlayer of Pd alloy is inhibited certainly, and the soldering disposition top effectiveness of said Pd or Pd alloy is fully demonstrated. Therefore, good soldering nature is obtained and remarkable effectiveness is done so on industry.

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(54)【発明の名称】　電子部品用導電材料

(57)【要約】

【課題】　半田付け性に優れる電子部品用導電材料の提供。

【解決手段】　導電性基体の表面にNi又はNi合金の下地層が形成され、その上に厚さが 0.005～0.1 μmのPd又はPd合金の中間層が形成され、更にその上に厚さが単原子層(0.001μm) ～ 0.1μmのAu又はAu合金の表層が形成されている。

【効果】　表層に耐酸化性に優れるAu層又はAu合金層を形成したものなので、その下方のPd又はPd合金の中間層の酸化が確実に抑止され、前記Pd又はPd合金の半田付け性向上効果が十分に発揮される。依って良好な半田付け性が得られる。

【特許請求の範囲】
【請求項１】　導電性基体の表面にNi又はNi合金の下地層が形成され、その上に厚さが 0.005～0.1 μmのPd又はPd合金の中間層が形成され、更にその上に単原子層(0.001μm）厚から 0.1μm厚のAu又はAu合金の表層が形成されていることを特徴とする電子部品用導電材料。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、半田付け性を改善した電子部品用導電材料に関する。
【０００２】
【従来の技術】ダイオード、トランジスター、ＩＣ等の半導体、コンデンサー、抵抗等の各種電子部品には、各々の素子部をプリント基板等の外部回路に接続する為のリード部が形成されている。このうちリード線やリードフレームの多くはCu、 Cu-Fe、Cu-Zn、 Cu-Sn等のCu合金、又はCu被覆鋼線等の線材にNiめっきした材料が主に用いられている。しかし、前記リード線等はNiめっき層が酸化し易い為、外部回路との接続を半田付けで行う際には酸化力の強いフラックスを用いてNiめっき層の酸化膜を除去する必要があった。この為作業環境が悪化するという問題があった。このようなことから、Niめっきリード線の半田付け性を改善する為に、Niめっき層の上に酸化し難いPd又はPd合金層を形成したリード線が提案された（特開昭59－149609号公報）。
【０００３】
【発明が解決しようとする課題】ところで、半導体の製造では、Siチップにリード材を 350～400 ℃の高温で半田付けする。又Si樹脂のキュアーは大気中で 200～250 ℃に加熱してなされる。このような熱履歴を受けると、前記の表層にPd（Pd合金）層をめっきしたリード線でも、前記Pd（Pd合金）層が僅かながら酸化して、外部導体との半田付け性が低下するという問題があった。本発明は、製造工程で加熱されても半田付け性が低下しない電子部品用導電材料の提供を目的とする。
【０００４】
【課題を解決するための手段】請求項１記載の発明は、導電性基体の表面にNi又はNi合金の下地層が形成され、その上に厚さが 0.005～0.1 μmのPd又はPd合金の中間層が形成され、更にその上に厚さが単原子層(0.001μm） ～ 0.1μmのAu又はAu合金の表層が形成されていることを特徴とする電子部品用導電材料である。
【０００５】
【発明の実施の形態】本発明の電子部品用導電材料は、従来の導電性基体上にNi（Ni合金）層とPd（Pd合金）層を順に形成したものの上に、耐酸化性に優れるAu（Au合金）層を更に形成したものであり、前記Au（Au合金）層がPd（Pd合金）層の酸化を防止してPd（Pd合金）の優れた半田付け性が有効に発現されるようにしたものである。
【０００６】本発明において、導電性基体にはCu又はCu合金線材を始めとする導電性を有する任意の金属材料が用いられる。特に、少なくとも表面にCu層又はCu合金層を有する導電性基体がめっき性に優れ望ましい。導電性基体は各種リード部の機械的強度や導電性の基準に応じて選定される。例えば、機械的強度が重視される場合はCu合金又はCu被覆鋼材が選ばれ、導電性が重視される場合はCuが選ばれる。
【０００７】本発明において、下地層にはNi又はNi合金が用いられる。前記Ni又はNi合金は耐熱性に優れ種々の加熱工程において導電性基体の表層への拡散を防止するバリヤとしての役目を果たす。前記Ni合金にはNi－Co系、Ni－Fe系、Ni－Zn系、Ni－Sn系、Ni－Co－P 系等の任意のNi合金が適用できる。
【０００８】本発明において、中間層にはPd又はPd合金が用いられる。前記Pd又はPd合金は半田付け性を向上させる。前記Pd合金にはPd－Ni系合金等が適用できる。中間層の厚さを 0.005～0.1 μmに規定した理由は、 0.005μm未満ではその効果が十分に得られず、 0.1μmを超えるとその効果が飽和し、コストアップを招くだけとなる為である。
【０００９】本発明において、表層にはAu又はAu合金が用いられる。前記Au又はAu合金は酸化し難く半田付け性を向上させる。前記Au合金にはAu－Pd系、Au－Co系、Au－Ni系、Au－Ag系等の合金が適用できる。前記表層の厚さを単原子層(0.001μm） ～ 0.1μmに規定した理由は、単原子層未満の厚さではその効果が全く得られず、0.1 μmを超えると半田中にSn-Au系金属間化合物が増加して半田接合性が劣化し、リード線が脱落する恐れがある為である。
【００１０】本発明のリード線の製造方法は、例えば、導電性基体を連続的に供給し、その上に下地層、中間層、表層を順に電気めっきする方法が生産性に富み適している。下地層のNi-B系合金やNi-P系合金等には従来より無電解めっきが多く採用されているが、電気めっきの方がめっき速度が速くコスト的に有利である。
【００１１】
【実施例】以下に、本発明を実施例により詳細に説明する。走行する 0.6mmφの無酸素銅線に電解脱脂、水洗、酸洗、水洗の前処理工程を施し、次いで下地層めっき、水洗、中間層めっき、水洗、表層めっき、水洗、乾燥のめっき工程を施し、これをコイル状に巻取ってリード線を製造した。製造設備には、前処理、各層のめっき、巻取りが連続的に行えるめっき設備を用いた。下地層、中間層、表層の材質及び厚さは種々に変化させた。比較の為、中間層の厚さが本発明の規定外のもの、Au（Au合金）層のないものについても実施例と同じ方法によりリード線を製造した。
【００１２】以下にめっき条件を記す。
〔Niめっき〕

めっき液：$NiSO_4$ 240g/l、 $NiCl_2$ 45g/l、 H_3BO_3 30g/l。
めっき条件：電流密度　5A/dm²、温度　50℃。
〔Ni-5wt%Co 合金めっき〕
めっき液：$NiSO_4$ 240g/l、 $NiCl_2$ 45g/l、$CoSO_4$ 15g/l、H_3BO_3　30g/l。
めっき条件：電流密度　5A/dm²、温度　55℃。
〔Pdめっき〕
めっき液：$Pd(NH_3)_2Cl_2$　40g/l、NH_4OH 90ml/l、 $(NH_4)_2SO_4$ 50g/l。
めっき条件：電流密度　1A/dm²、温度　30℃。
〔Pd-20wt%Ni合金めっき〕
めっき液： $Pd(NH_3)_2Cl_2$ 40g/l、 $NiSO_4$ 45g/l、NH_4OH 90ml/l、$(NH_4)_2SO_4$　50g/l。
めっき条件：電流密度　1A/dm²、温度　30℃。
〔Auめっき〕
めっき液：$KAu(CN)_2$ 15g/l、 KCN 30g/l、 K_2CO_3 30g/l、 Na_2HPO_4 20g/l。
めっき条件：電流密度　0.5A/dm²、温度　60℃。

【００１３】得られた各々のリード線を大気中で 180℃に24時間加熱したのち半田濡れ性と半田接合性を調べた。半田濡れ性は MIL法に準じて調べた。即ち、リード線を長さ30mmに切断してピンとし、これをアセトンで十分洗浄したのち 230℃に加熱した共晶半田浴に５秒間浸漬し、ピンに付着した半田の面積（濡れ面積）を15倍の拡大鏡を用いて測定した。この半田付着面積をピンの浸漬面積で徐して半田濡れ性を表した。半田接合性は各々のリード線を共晶半田浴に浸漬して半田を付着させ、この半田付着部分を銅条に接触してリード線と銅条とを半田付けし、この半田付けしたリード線と銅条とを 155℃のエアバス内に 100時間放置後、リード線と銅条をそれぞれチャックに挟んで引張試験を行って調べた。条と半田間で破断したものは半田接合性が良好（○）、めっき層と半田間で剥離が生じたものは半田接合性が不良（×）と判定した。以上の試験を各試料について５本づつ行った。結果を表１に示す。
【００１４】
【表１】

分類	No	下地層 材種	下地層 厚さ μm	中間層 材種	中間層 厚さ μm	表層 材種	表層 厚さ μm	半田濡れ性 ※ %	半田接合性 §
本発明例	1	Ni	0.5	Pd	0.005	Au	0.001	95.2	○
	2	Ni	0.5	*Pd-Ni	0.01	Au	0.01	98.1	○
	3	Ni	0.5	Pd	0.01	Au	0.1	98.7	○
	4	Ni	0.5	Pd	0.1	Au	0.01	99.2	○
	5	#Ni-Co	0.5	Pd	0.01	Au	0.01	98.2	○
比較例	6	Ni	0.5	Pd	0.003	Au	0.01	83.0	○
	7	Ni	0.5	Pd	0.01	なし		60.5	○
	8	Ni	0.5	Pd	0.1	なし		74.8	○
	9	Ni	0.5	Pd	0.1	Au	0.2	99.5	×

（注）※：５本の平均値。§：○は５本とも○、×は５本とも×。
*:Pd-20wt%Ni 合金。 #:Ni-5wt%Co合金。

【００１５】表１より明らかなように、本発明のリード線 (No.1～5)はいずれも、半田濡れ性と半田接合性に優れている。他方、比較例品のNo.6はPd層が薄い為半田濡れ性が低下した。又No.7,8はAu層がない為大気中 180℃の加熱でPd層の表面が僅かながら酸化して半田濡れ性が低下した。No.9は接合性に劣化が見られるが、これは Au-Sn系金属間化合物が多く形成された為である。
【００１６】以上、リード線について説明したが、本発明の導電材料は、リードフレーム等、他のリード部に用いても同様の効果が得られるものである。
【００１７】
【発明の効果】以上に述べたように、本発明のリード線

は、表層に耐酸化性に優れるAu層又はAu合金層を形成したものなので、その下方のPd又はPd合金の中間層の酸化が確実に抑止され、前記Pd又はPd合金の半田付け性向上効果が十分に発揮される。依って良好な半田付け性が得られ、工業上顕著な効果を奏する。

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